129g Generalized Hydraulic Calculation Method for Non-Newtonian Flow in Eccentric Annuli

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Abstract: The flow of non-Newtonian fluids through eccentric annuli is prevalent during drilling and cementing operations of directional and horizontal oil and gas wells. The flow pattern in an eccentric annulus can differ greatly from that in a concentric annulus, and this difference affects both the pressure drop and the laminar-turbulent transition point. When the flow regime is the same, either laminar or turbulent, in both geometries, the pressure drop is much lower in a fully eccentric annulus. However, the transition from laminar to turbulent flow begins at a lower Reynolds number or flow rate in an eccentric annulus. Therefore, the pressure drop may be higher in an eccentric annulus under certain conditions. Errors resulting from ignoring the effect of eccentricity on frictional pressure drop and equivalent circulating density can lead to formation fracture or well control problems.

In this paper a new method is presented for calculating pressure losses in eccentric annuli. The method is based on an effective diameter that accounts for the effects of both conduit geometry and fluid rheology. Predictions of the method are compared with an extensive set of data for drilling fluids obtained from a large-scale flow loop. The results demonstrate that the new method is capable of reliably predicting the pressure drop of most drilling fluids in both laminar and turbulent flow regimes for eccentric annular geometries of practical interest.